The Associations Between Sleep and Externalizing and Internalizing Problems in Children and Adolescents with Attention-Deficit/Hyperactivity Disorder: Empirical Findings, Clinical Implications and Future Research Directions

Dimakos, Jenny. BSc., Attention, Behaviour and Sleep Lab, Douglas Mental Health University Institute, Montréal, QC H4H 1R3, Canada; Faculty of Medicine, Integrated Program in Neuroscience, McGill University, Montréal, QC, Canada jenny.dimakos@mail.mcgill.ca

Gauthier-Gagné, Gabrielle. BA., Attention, Behaviour and Sleep Lab, Douglas Mental Health University Institute, 6875 LaSalle Boulevard, Verdun, Montréal, QC H4H 1R3, Canada gabrielle.gauthier-gagne@mail.mcgill.ca

Lin, Lanyi. BSc., Attention, Behaviour and Sleep Lab, Douglas Mental Health University Institute, 6875 LaSalle Boulevard, Verdun, Montréal, QC H4H 1R3, Canada lanyi.lin@mail.mcgill.ca,

Scholes, Samantha. BA., Attention, Behaviour and Sleep Lab, Douglas Mental Health University Institute, 6875 LaSalle Boulevard, Verdun, Montréal, QC H4H 1R3, Canada; Department of Educational and Counselling Psychology, McGill University, Montréal, QC, Canada samantha.scholes@mail.mcgill.ca

Gruber, Reut. PhD., Attention, Behaviour and Sleep Lab, Douglas Mental Health University Institute, Montréal, QC H4H 1R3, Canada; Department of Psychiatry, Faculty of Medicine, McGill University, Montréal, QC, Canada
Email reut.gruber@douglas.mcgill.ca

Corresponding Author:
Reut Gruber, PhD Associate Professor, Department of Psychiatry, Faculty of Medicine, McGill University
Director, Attention, Behavior and Sleep Lab, Douglas Mental Health University Institute
Montréal, QC, Canada
Reut.gruber@douglas.mcgill.ca

Disclosure

The authors report no conflicts of interest in this work.

Synopsis

Sleep problems are common in youth with Attention-Deficit/Hyperactivity Disorder (ADHD). Externalizing and internalizing problems contribute to dysfunction in youth with ADHD and are amplified by disrupted sleep. This objective of this article is to synthesize empirical studies that examined the associations between sleep and internalizing or externalizing problems in individuals with ADHD. The main findings are that sleep problems precede, predict, and significantly contribute to the manifestation of internalizing and externalizing behavior problems among children and adolescents with ADHD. Clinicians should assess sleep and integrate sleep interventions into the management of youth with ADHD.

Keywords: Sleep, ADHD, Externalizing, Internalizing, Youth, Children, Adolescents

Key points:

- Attention-Deficit/Hyperactivity Disorder is associated with comorbid sleep disturbances.
- Sleep problems are associated with internalizing and externalizing symptoms in youth with ADHD.
- Sleep problems precede, predict, and significantly contribute to the manifestation of internalizing and externalizing behavior problems; this association is bi-directional with regards to associations between sleep disturbances and internalizing symptoms.
- Clinicians should assess sleep and integrate sleep intervention into the management of youth with ADHD.
- Future research is needed to examine the mechanisms underlying the associations between sleep and internalizing and externalizing problems in youth with ADHD.

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention, impulsivity, and/or hyperactivity that affects 5 to 7% of school-age children and adolescents[1,2]. Early deficits in executive functions (EF), a set of cognitive abilities responsible for goal-directed behavior, have been identified as an etiological risk factor for ADHD[3], as has decreased activation in the frontoparietal networks and ventral attentional network, which are brain systems known to be involved in EF[4]. In addition to the core symptoms listed above, emotional symptoms and poor self-regulation are increasingly considered core features of ADHD. Low frustration tolerance, irritability, ease of negative emotional experience, and emotional lability are frequent in children and adolescents with ADHD[5-8]. These challenges can result in internalizing (e.g., anxious, depressed mood) and/or externalizing (e.g., oppositional/defiance, poor conduct, irritability) behavioral problems, which are major contributors to the social, occupational, educational, and relational impairments seen in individuals with ADHD. Because the outcomes of such problems are often severe, it is important that we understand the upstream pathways and seek to identify innovative, treatable intervention goals.

Inadequate sleep has been reported in up to 70% of children with ADHD[9-17], compared with 20 to 30% of children in the general population[18]. The sleep problems experienced by children with ADHD include unhealthy lifestyle choices such as excessive evening screen use or insufficient sleep[19-21], behavioral problems (e.g., difficulties initiating and/or maintaining sleep)[22,23], and primary sleep disorders, such as Sleep Disordered Breathing (SDB), Sleep Apnea, Restless Leg Syndrome (RLS), Delayed Sleep Phase Syndrome (DSPS), Insomnia, and Narcolepsy[24-30].

The neural areas that govern self-regulation and EF (e.g., the dorsolateral prefrontal, anterior cingulate, and parietal cortices) are sensitive to sleep deprivation[31-35]. Sleep loss acutely impairs the EF necessary for effective behavioral or self-regulation, especially in the face of frustration[36-38]. The brain regions responsible for exerting top-down control are particularly sensitive to sleep deprivation. For example, the connectivity between the amygdala and medial Prefrontal Cortex (PFC) is reduced under sleep deprivation, leading to greater amygdala activation in response to negative emotional stimuli[39-41]. In children, impairments in these cognitive processes manifest as irritability and behavioral outbursts corresponding to internalizing or externalizing behaviors[42].

The behaviors and self-regulatory processes that are affected by inadequate sleep, namely EF and externalizing/internalizing behaviors, are also key domains of dysfunction in youth with ADHD[36,43]. Among children predisposed to behavioral difficulties, such as those with ADHD, the impact of disrupted sleep may be amplified[28,44]. Hence, the characteristics of ADHD may increase both the risk for and the vulnerability to insufficient sleep. There are documented associations between various domains of sleep and both internalizing/externalizing symptoms and the negative impacts of these symptoms on youth with ADHD[45-48]. However, we know little about the nature of the associations between sleep and these symptoms in youth with ADHD.

Addressing this knowledge gap is important as it could provide valuable intervention targets that could be used to reduce daytime impairments among youth with ADHD. If inadequate sleep predicts, causes, or worsens internalizing and externalizing problems over time, then improved sleep could be a way to reduce the burden of such mental health problems among children with ADHD. The objectives of this article are to: 1) integrate the up-to-date empirical

evidence; 2) extract clinical implications; and 3) identify future research directions regarding the associations between sleep and externalizing or internalizing problems in youth with ADHD.

Methods

This narrative review identifies and synthesizes empirical studies that examined the associations between sleep and internalizing or externalizing problems in youth with ADHD. Three electronic databases were searched in March 2020 (Embase, PsycINFO, and PubMed) for studies published in the prior 5 years. Additional records were identified by searching the references of the selected original research papers and review articles.

Ultimately, 11 studies were identified (see Figure 1 for detailed information regarding the literature search, numbers of papers identified, inclusion and exclusion of identified studies) and divided into three age groups: preschool (3-5 years), school-age (6-12), and adolescents (13-18). Sleep measures were identified as subjective or objective. Subjective sleep measures refer to questionnaires filled out by the patient or a parent regarding the child's sleep behavior or symptoms. Objective measures included polysomnography (PSG) and actigraphy. PSG refers to a sleep assessment during which multiple physiologic parameters are continuously and simultaneously recorded across a sleep period to characterize sleep and identify sleep disorders[49]. Actigraphy is a method of measuring sleep parameters and average motor activity over a period of days to weeks using a non-invasive accelerometer, which is housed in a small device worn like a wristwatch[50-52].

Externalizing behaviors including oppositionality, aggression, irritability and conduct problems were assessed using only parent-reported measures. Internalizing behaviors including symptoms of anxiety and depression were assessed using both self- and parent-report measures.

The dimensions of sleep assessed included: sleep duration; sleep continuity; and reported sleep disturbances. (See Table 1. for summary of studies).

Results

Key Findings

Sleep and externalizing problems in children and adolescents with ADHD

Preschool children. One cross-sectional study was conducted to examine the associations between sleep and externalizing problems in preschool children. It used concurrent subjective measures of sleep and behavior in preschool-aged children at risk for or with a clinical diagnosis of externalizing problems. This study revealed that children described by their parents as being more oppositional were reported to have poorer habits near bedtime and more night wakings[53].

School-age children**.** In school-age children, a cross-sectional study grouped participants according to ADHD presentation and the presence of comorbidity. Sleep and daily functioning were measured using parental reports. Sleep problems were associated with impairment in daily functioning regardless of diagnostic status, but the correlation was stronger in the group of children with ADHD and internalizing comorbidity, and highest in children with ADHD and externalizing comorbidity compared to all other comorbid conditions or controls[54]. Another cross-sectional study examined the associations between objective and subjective sleep measures and irritable-angry mood and temper outbursts in children with and without ADHD[55]. Significant associations were found between the objective PSG parameters and Disruptive Mood Dysregulation Disorder (DMDD) in children in the control group. In addition, children with elevated sleep problems had significantly higher levels of DMDD symptoms than children without sleep problems[55]. Of the two longitudinal studies conducted with school-age children to examine casual and bidirectional associations between sleep problems and externalizing problems, one study failed to find a

bidirectional relationship between reported sleep problems and externalizing problems[56]. However, the other longitudinal study revealed that children with ADHD and transient or persistent reported sleep problems had higher behavioral and conduct problems compared to children with ADHD without sleep problems over a 12-month period[57].

Adolescents**.** Three studies have been conducted to examine if shortened sleep duration is a causal contributor to daytime behavior and self-regulation in adolescents with ADHD. Of them, one study used a within-subject, crossover design, sleep restriction/extension protocol over 3 weeks to examine if sleep duration is a causal contributor to poorer/improved daytime functioning[58]. The protocol included one stabilization week, one sleep extension (SE) week in which participants obtained 9 hours of nightly sleep, and one sleep restriction (SR) week during which participants obtained 6.5 hours of nightly sleep. All adolescents participated in both the SR and SE conditions, with the order of conditions randomly counterbalanced across participants. Sleep information was obtained using actigraphy and daily diaries, and behavioral information was obtained using parent and self-reported daily ratings of inattention, hyperactivity/impulsivity and oppositionality on a 4-point scale. Across both daily and weekly measures, parents reported significantly greater inattention and oppositional behaviors during SR compared to SE. Parents did not report greater hyperactivity/impulsivity during restriction compared to extension, but adolescents reported less hyperactivity/impulsivity during restriction compared to extension[58]. The other studies used a longitudinal design to examine the role of sleep in the development of externalizing behaviors in adolescents with ADHD. In Becker et al. (2015)[46], sleep problems were found to account for 5% of the variance in predicting youths' ODD/externalizing behaviors and an additional 4% of the variance in predicting youths' depressive symptoms after accounting for youth characteristics and the stability of psychopathology over a 1-year period[46]. Mulraney et al. (2017)[59] followed children

with externalizing problems from age 10 to 14; they found that these children had higher parent-reported irritability at the follow-up assessment in adolescence, and that this was associated with sleep problems.

Sleep and internalizing problems in children and adolescents with ADHD

Preschool children. No study has examined the interplay between internalizing problems and sleep in preschool children with ADHD.

School-age children. In school-age children, a cross-sectional study revealed that children with clinical sleep problems and ADHD reported higher levels of anxiety compared to children with ADHD and no or sub-clinical sleep problems[60]. Children's anxiety level and medication status were significantly associated with their sleep score, whereas ADHD symptom severity did not significantly correlate with the sleep score[60]. Another large cross-sectional study with school-age children with ADHD-Inattentive presentation revealed significant associations between anxiety, shorter sleep duration, and poorer sleep[61]. In addition, this study found an association between depressive symptoms and children's need to catch up on sleep on the weekends. A longitudinal study conducted at three time points with school-age children over a 12-month period found a bidirectional relationship between parent-reported sleep problems and internalizing difficulties; sleep problems at baseline predicted internalizing difficulties 6 months later, and internalizing difficulties at baseline predicted sleep problems 6 months later[56]. Another longitudinal study revealed that children with ADHD and transient or persistent reported sleep problems had higher emotional problems compared to children with ADHD without sleep problems over a 12-month period[57].

Adolescents. Compared to studies in school-age children, contrasting results were obtained in an experimental sleep restriction/extension protocol that examined the impact of shortened sleep

duration on internalizing symptoms, emotional regulation, and affect valence in adolescents with ADHD[62] (for protocol information see[58]). This study found significantly greater parent- and adolescent-reported depressive symptoms during sleep restriction compared to sleep extension, and less positive affect and more negative affect during sleep restriction compared to extension across both daily diary and laboratory-visit measures. However, no significant difference was found for parent- or adolescent-reported anxiety. In addition, one longitudinal study failed to find an association between baseline sleep problems and anxiety symptoms one year later[46].

Methodological Characteristics of the Included Studies

Of the 11 studies included in this review, 5 were cross-sectional studies that concurrently examined sleep behavior or problems and the extent to which youth with ADHD exhibited internalizing or externalizing behavior problems[53-55,60,61]; 4 used longitudinal designs examining the predictive role of sleep problems in the development of externalizing or internalizing behavioral problems in youth with ADHD and assessing the bi-directional associations between sleep problems and behavioral problems in youth with ADHD[46,56,57,59]; and 2 were experimental studies in which sleep duration was manipulated in order to test its impact on youth daytime behaviors[58,62]. The total number of youth with ADHD examined across all the studies was 2,123; the smallest study included 48 participants with ADHD and the largest included 784. All of the studies included more boys than girls, with ratios ranging from 59 to 89% males. The studies used objective sleep measures in addition to using subjective parental reports and/or child self-reports regarding sleep disorders, behavior, and/or patterns. The utilized scales had moderate reliability (α = .45-.79). Three studies used a measure that was not designed for the age group in which it was applied[54,56,60]. The measured aspects of sleep included a range of proxies for sleep disorders,

disturbances and sleep duration. Eight studies used the same informants to obtain information regarding the child's sleep and daytime behavior[53-57,59-61], while 3 studies used different informants for sleep vs. daytime behavior[46,58,62]. Eight studies measured and controlled for confounding variables (e.g., sex, age, SES, medication status, or comorbid conditions) in their analyses[46,53,54,56,59-61].

Discussion

Externalizing and internalizing problems are common in youth with ADHD, resulting in suffering and impaired daytime functioning. Sleep plays a central role in regulating emotions and behavior, such that daytime functioning is benefited by healthy sleep but impaired by inadequate or disturbed sleep. Sleep problems are common in youth with ADHD. In spite of the importance of healthy and adequate sleep to behavior and self-regulation, there has been no comprehensive review of the interplay between sleep and internalizing and externalizing problems in youth with ADHD. The primary goal of this review was to address this gap and integrate available evidence regarding how and to what extent sleep disturbances or patterns are associated with internalizing and externalizing symptoms in youth with ADHD. The results of the review reveal that: 1) sleep problems are associated with internalizing and externalizing symptoms in youth with ADHD; 2) sleep problems precede, predict, and significantly contribute to the manifestation of internalizing and externalizing behavior problems; 3) this association is bi-directional with regards to associations between sleep disturbances and internalizing symptoms; and 4) sleep restriction is causally associated with internalizing and externalizing symptoms in adolescents with ADHD.

The current review drew on a small body of evidence from 11 studies with 2,123 participants. Cross-sectional studies across different age groups, from preschool to adolescence, showed significant, positive, and small to medium-size associations between reported sleep

problems and both internalizing and externalizing symptoms. The significance was held in the studies that controlled for sex, parental education or income, and/or comorbid psychiatric conditions. Longitudinal studies revealed similar results, with small associations found between sleep problems reported at an earlier time point and internalizing or externalizing symptoms at a later time point. The nature of the co-occurring internalizing problems differed across studies. One found that sleep problems longitudinally or experimentally predicted increases in depressive symptoms in adolescents with ADHD, but were not associated with anxiety [46,62]. However, other studies found that sleep problems in youth with ADHD were associated with anxiety but not depression[60,61]. Future research should seek to further differentiate the impact of sleep disturbances on depression and anxiety in youth with ADHD, as these symptoms might require different intervention strategies[63,64].

An experimental study revealed the existence of causal associations between shorter sleep duration and oppositional behavior, inattention, and depressive symptoms in adolescents diagnosed with ADHD[58]. This was consistent with previous work demonstrating that cumulative sleep restriction caused deterioration of neurobehavioral functioning from subclinical to clinical values in children with ADHD[14]. It is also consistent with recent work[65], showing an association between short sleep duration and increased risk of future occurrence of behavioral disorder symptoms in children with ADHD.

Clinical Implications

Since sleep disturbances are so closely associated with internalizing and externalizing problems in youth with ADHD, they may be considered important modifiable risk factors. Hence, improving the sleep of youth with ADHD and internalizing and/or externalizing problems during developmental periods of neuro-maturation could powerfully impact their emotional and

behavioral health. Sleep improvement could be obtained in several steps. First, sleep assessment should be integrated into the evaluation process of youth with ADHD on a routine basis[66]. Initial distinction should be made as to the nature of the sleep issue(s). If a child/adolescent presents with unhealthy sleep patterns such as insufficient sleep, inconsistent sleep patterns, and/or excessive screen time use, an intervention that seeks to promote the adoption of health behaviors conducive to good sleep may offer providers a relatively modifiable target to reduce the emotional and behavioral problems of youth. Simple behavioral sleep recommendations could include limiting screen time, large meals, and physical activity undertaken in the final hour before bed; keeping a consistent bedtime routine and sleep schedule; avoiding caffeine; and using the bed only for sleep[67].

Second, if a clinical sleep disorder is suspected, it is important to take a detailed clinical history and use objective sleep measures as recommended in the International Classification of Sleep Disorders (ICSD-3)[68]. This is essential in order to obtain an accurate diagnosis for one or more concomitant sleep disorders that might be comorbid with ADHD.

Third, the treatment must be selected based on the identified sleep disorder(s). For children with ADHD and SDB, surgical removal of the adenoids or tonsils is a first-line treatment [69,70]. For individuals with ADHD and RLS, behavioral interventions could include modifying the sleep environment; and treatment with iron supplementation (e.g., ferrous sulfate) or gabapentin could be considered[71,72]. For individuals with ADHD and DSPS, treatment with light therapy[73], chronotherapy[74], and the use of timed melatonin treatment could be helpful[75]. Treatment for individuals with ADHD and insomnia will vary according to the age group, and a clear distinction must be made between insomnia and DSPS, as their treatments will differ. For children with ADHD and insomnia, behavioral treatments such as positive reinforcement, scheduled

awakenings, unmodified extinction, and faded bedtime could be starting options[76]. For adolescents with ADHD and insomnia, recent studies have demonstrated that cognitive behavioral therapy for insomnia (CBT-I) should be considered as the first line of treatment[77-79]. For individuals with ADHD and narcolepsy, treatment with modafinil, sodium oxybate, or psychostimulants is indicated, and this treatment can be supplemented with education on sleep hygiene[80].

Limitations and Future Research Directions

Clear evidence has been found for significant associations between sleep problems and symptoms of internalizing and externalizing psychopathology in youth with ADHD, yet most of the reports have noted the presence of multiple weaknesses. Progress in the field is needed for both conceptualization and methodology.

Conceptually, little is known about the mechanisms underlying the associations between youth sleep and internalizing and externalizing problems. Impaired sleep leads to deficits in EF, which have been consistently associated with internalizing/externalizing problems and poor self-regulation in youth[46,47,81]. Future research is needed to examine if an EF deficit is a common mechanism underlying the associations between sleep and internalizing and externalizing problems in youth with ADHD. A growing body of evidence indicates that individuals with ADHD are likely prone to having an evening chronotype and disturbed circadian mechanisms[82]. Individuals with evening preferences have been shown to be more likely to present behavioral problems and psychopathology[83]. It is therefore possible that circadian abnormality underlies the associations between sleep disturbances and internalizing/externalizing behavior problems. Each of these possibilities is a fruitful avenue for investigations into mechanisms that might underlie the associations between sleep, internalizing or externalizing problem behaviors, and ADHD.

Multiple methodological weaknesses limit the contributions of the reviewed studies. First, the utilized measures provided limited information about the aspects of sleep that are specifically associated with externalizing or internalizing symptoms. Some of the studies used a single-item measure of sleep problems, and thus were not specific in identifying the particular sleep behaviors that contributed most to the manifestation of internalizing or externalizing symptoms. Most of the other studies used scales that were general and lumped multiple observed symptoms of sleep disturbances. It therefore not known which aspects of sleep (i.e., duration, continuity, timing, or consistency) cause or contribute to behavioral problems. This limits our ability to identify what aspect(s) of sleep could be associated with daytime symptoms and renders it impossible to generate specific clinical recommendations pertaining to the sleep dimensions likely to have the most clinical impact.

A second methodological limitation is the common sole use of parent-report measures to determine youth sleep problems in pre-school and school-age children. This method of subjective report is prone to bias and does not allow for a complete understanding of sleep functioning. In addition, the studies did not include other relevant domains, such as circadian preferences (chronotype), even though such domains are known to have relationships with youth self-regulation abilities[84]. Future studies would benefit from using both subjective and objective sleep measures to better understand the relationships among distinct sleep-related domains and determine where intervention efforts would best be placed. For example, actigraphy can capture actual behavioral sleep patterns and questionnaires about chronotype can reveal behavioral preferences for sleep. In addition, future research would benefit from obtaining both parent and youth reports of these domains and using objective measurements of behavior.

A third limitation is the heterogeneity of the study designs. Some excluded participants with comorbidities, some included these individuals to better reflect clinical practice and improve generalizability, and others did not report or control for these participants. Control of medication use, particularly psychostimulants, was also inconsistent. Future studies should investigate whether implementing a sleep problem intervention can decrease the occurrence of both externalizing and internalizing difficulties. Studies seeking to further elucidate the longitudinal and bidirectional associations between sleep and internalizing and externalizing difficulties examined at multiple time points over regular intervals and using consistent measures will inform the focus and timing of intervention efforts. Concerning demographic factors, there were significantly lower rates of girls than boys. This is consistent with the idea that ADHD may be less frequently identified in girls than in boys[85], but the discrepancy could have biased the findings.

Finally, all studies failed to include multiple other factors that are likely to influence sleep and behavior, including parental mental health[86], physical aspects of the environment, and/or school start time[87-89], and only a few studies controlled for socioeconomic status. Future research should aim to investigate the longitudinal and likely reciprocal relations among these factors and children's sleep and self-regulatory functioning in both clinical and nonclinical populations.

Clinical Care Points

- Conduct a baseline sleep evaluation during the initial assessment of problems in order to determine habitual sleep duration, identify poor sleep hygiene, and screen for a potential sleep disorder/s
- Include sleep improvement in your treatment plan
- Include sleep health monitoring as part of your ongoing clinical management
- Collaborate with a sleep specialist when conducting assessment or planning treatment for a co-morbid sleep disorder.
- Assess the extent to which a sleep problem could cause or contribute to daytime behavioral, emotional, or cognitive impairments
- Reassess daytime impairment/s once sleep habits or disorder/s have been treated
- When considering psychotropic medication/s take into consideration potential benefits / adverse effects on sleep and daytime alertness

Author and year	Study Design	Sample	Age Range (Mean +/- SD)	Comorbid Disorders	ADHD Diagnosis	Sleep Measures (Informant; Reliability)	Sleep Dimension(s)	Symptoms Measures		Results
								Externalizing (Informant; Construct measured)	Internalizing (Informant; Construct measured)	Associations Between Sleep and Internalizing or Externalizing Symptoms
Coto et al., 2018 [53]	Cross-sectional	148 (82% Male)	3 to 6 (5.06 +/- N/A)	ODD (46%)	C-DISC-IV or K-DBDS	Abbreviated CSHQ (Parent; α=.68-.73)	Reported Sleep Disturbances	DBRS-PV (Parent; Oppositionality/aggression)	N/A	Higher scores on parent-reported oppositionality/aggression were positively correlated with higher levels of sleep problem scores (r = .27, p < .01)
Virring et al., 2014 [54]	Cross-sectional	188 Control (52% Male); 209 ADHD (79% Male)	6 to 13 (Controls (9.7 +/- 1.5); ADHD (9.6 +/- 1.9)	Externalizing disorders (57%); Internalizing disorders (24%); ASD (8%); Tics and Tourette syndrome (11%)	DAWBA	CSHQ (Parent; α =.62-.73)	Reported Sleep Disturbances	WFIRS (Parent; Daily functioning)	N/A	Higher sleep problem scores on the CSHQ were associated with externalizing problems in children with ADHD (r = .50 [0.38, 0.60]) and in the control group (r = .46 [0.31, 0.57]);
Waxmonsky et al., 2017 [55]	Cross-sectional	665 Control (53% Male); 784 ADHD (68% Male)	6 to 12 (Typically developing 8.7 +/- 1.7; ADHD 8.3 +/- 1.8)	ODD; CD; Anxiety; and Depression	Psychological evaluation (child, parent, teacher) and psychological testing	Sleep Problems Subscale PBS (Parent; α =.45); PSG for controls	Reported Sleep Disturbances	PBS (Parent; Irritable-angry mood)	N/A	In children with ADHD, higher levels of DMDD symptoms were positively correlated with higher sleep problem scores (r = .28, p < .05); Children with ADHD and elevated sleep problem scores had significantly higher DMDD symptoms than children with ADHD without elevated sleep problems scores (t = 5.4, p < 0.0001)
Mulraney et al., 2016 [56]	Longitudinal	270 (86% Male)	5 to 13 (10.1 +/- 1.9)	ASD (24%)	Previous diagnosis by a pediatrician	CSHQ (Parent; α =.62-.73)	Reported Sleep Disturbances	SDQ (caregiver; Conduct problems)	SDQ (Caregiver; Emotional problems)	Higher sleep problem scores on the CSHQ at baseline in children aged 5 to 13 predicted internalizing problems 6 months later (β = .17, p < .01) and internalizing problems at baseline predicted sleep problems 6 months later (β = .07, p < .05) in children aged 5-13; No predictive relationship between sleep problem scores and internalizing problems between 6 and 12 months; No bidirectional relationship found between externalizing problems and sleep problem scores on the CSHQ

Lycett et al., 2016 [57]	Longitudinal	186 (87% Male)	5 to 13 (10.1 +/- 1.8)	Externalizing and Internalizing (36%)	Previous ADHD Diagnosis	Caregiver report (not standardized)	Reported Sleep Disturbances	SDQ (caregiver; Conduct problems)	SDQ (Caregiver; Emotional problems)	Children with ADHD and transient or persistent reported sleep problems had higher conduct problem subscale scores (*ps*. < .001 and .04, respectively) and higher emotional problem subscale scores (*ps*. < .001 and .02, respectively) compared to children with ADHD without sleep problems over a 12-month period
Becker et al., 2019 [58]	Experimental	48 (75% Male)	14 to 17 (15.21 +/- 1.15)	Depression (2%); GAD (8%); ODD (4%); Any Comorbidity (12%)	K-SADS	Actigraphy; SD	Duration	VADRS (Parent, ODD symptoms), IOWA-10 (Parent; ODD symptoms)	N/A	Paired samples t-test revealed higher levels of oppositional behaviors on the daily ($t = 2.99$, $p = .004$) and weekly ($t = 2.24$, $p = .03$) measures during sleep restriction compared to sleep extension condition
Becker et al., 2015 [46]	Longitudinal	81 (75% Male)	10 to 14 (12.2 +/- .95)	N/A	P-ChIPS	CBCL (Parent; $\alpha = .61$)	Reported Sleep Disturbances	DBD (Parent; ODD symptoms); SSIS (Parent; Externalizing behaviors)	RADS-2 (Self; Depressive symptoms); MASC (Self; Anxiety symptoms)	Regression analyses revealed that higher sleep problem scores at T1 in children aged 10-14 significantly predicted higher levels of ODD symptoms ($\beta = .26$, $p = .008$), higher levels of externalizing problems ($\beta = .26$, $p = .01$), and higher levels of depressive symptoms ($\beta = .23$, $p = .045$) at T2 one year later. Sleep problem scores at T1 did not significantly predict anxiety symptoms one year later
Mulraney et al., 2017 [59]	Longitudinal	140 (89% Male)	5 to 13 (10.2 +/- 1.9)	Internalizing (60%); Externalizing (56%); Internalizing and Externalizing (39%)	Previous diagnosis by pediatrician and ADHD Rating Scale IV	DIMS subscale of SDSC (parent; $\alpha = .79$)	Continuity	ARI (Parent; Irritability)	N/A	Univariate linear regressions revealed higher levels of sleep problem scores were associated with greater parent-reported irritability scores ($\beta = .28$, $p = .002$)

Bar et al., 2015 [60]	Cross-sectional	62 (68% Male)	6 to 17 (10.09 +/- 2.68 for clinical sleep disturbance and 9.80 +/- 2.41 for non-clinical sleep disturbance)	Any psychiatric diagnosis (34%); Anxiety (16%); LD (17%); Tic disorder (2%); CD (11%)	Previous diagnosis by a psychiatrist	CSHQ (Parent; α =.62-.73	Reported Sleep Disturbances	N/A	SCARED (Parent; anxiety)	Regression analysis revealed that higher levels of parent-reported anxiety were significantly associated with higher sleep problem scores (β = .27, p < .05)
Becker et al., 2016 [61]	Cross-sectional	147 (59% Male)	7 to 11 (8.62 +/- 1.17)	Internalizing; ODD; SCT	K-SADS	Parent Inventory of Children's Sleep Habits	Duration; Continuity; Reported Sleep Disturbances	CSI-4 (Parent; ODD symptoms)	CSI-4 (Parent; Anxiety & Depression symptoms)	Associations between ODD symptom scores and sleep functioning domain scores were not significant. Higher levels of anxiety symptom scores were associated with shorter sleep duration (r = -.19, p < .05), being a poor sleeper (r = .33, p < .001), and more frequent night wakings (r = .22 p < .01); Higher levels of depressive symptoms were positively correlated with weekend catch up sleep (r = .22, p < .01)
Becker et al., 2020 [62]	Experimental	48 (75% Male)	14 to 17 (15.21 +/- 1.15)	Depression (2%); GAD (8%); ODD (4%); Any Comorbidity (12%)	K-SADS	Actigraphy; SD	Duration	N/A	RCADS (Self and Parent; Anxiety and Depression symptoms); Depressed Mood Subscale of SHS (Self; depressive symptoms); PANAS (Self and Parent; Affect)	Paired samples t-test revealed higher levels of parent and self-reported depressive symptoms (t = -5.80, p < .001 and t = -2.16, p = .36, respectively), lower levels of positive affect (t = 4.96, p < .001), and higher levels of negative affect (t = -3.05, p = .004) during the sleep restriction condition compared to the sleep extension condition

Note: ADHD (Attention-Deficit/Hyperactivity Disorder); ODD (Oppositional Defiant Disorder); C-DISC-IV (Diagnostic Interview Schedule for Children computerized version IV); K-DBDS (Kiddie-Disruptive Behavior Disorder Schedule); CSHQ (Children's Sleep Habit Questionnaire); DBRS-PV (Disruptive Behavior Disorders Rating Scale – Parent Version); CD (Conduct Disorder); PBS (Pediatric Behavior Scale); PSG (Polysomnography); DMDD (Disruptive Mood Dysregulation Disorder); ASD (Autism Spectrum Disorder); DAWBA (Development and Well-Being Assessment); WFIRS (Weiss Functional Impairment Rating Scale); SCT (Sluggish Cognitive Tempo); K-SADS (Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children); CSI-4 (Child Symptom Inventory-4); SDQ (Strength and Difficulties Questionnaire); DIMS (Disorders in Initiating and Maintaining Sleep); SDSC (Sleep Disturbance Scale for Children); ARI (Affective Reactivity Index); LD (Learning Disorder); SCARED (Screen for Child Anxiety Related Disorders); P-ChIPS (Children's Interview for Psychiatric Syndromes—Parent Version); CBCL (Child Behavior Checklist); DBD (Disruptive Behavior Disorders); SSIS (Social Skills Improvement System); RADS-2 (Reynolds Adolescent Depression Scale, Second Edition); MASC (Multidimensional Anxiety Scale for Children); SD (Sleep Diaries); RCADS (Revised Child Anxiety and Depression Scales); SHS (Sleep Habits Survey); PANAS (Positive and Negative Affect Scale); GAD (Generalized Anxiety Disorder); VADRS (Vanderbilt ADHD Diagnostic Rating Scale – Parent Version); and IOWA-10 (IOWA Conners Rating Scale)

References

1. Polanczyk GV, Willcutt EG, Salum GA, Kieling C, Rohde LA. ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *International journal of epidemiology.* 2014;43(2):434-442.
2. Association AP. Diagnostic and statistical manual of mental disorders (DSM-5®): American psychiatric pub; . 2013.
3. Nigg JT, Goldsmith HH, Sachek J. Temperament and attention deficit hyperactivity disorder: the development of a multiple pathway model. *J Clin Child Adolesc Psychol.* 2004;33(1):42-53.
4. Cortese S, Kelly C, Chabernaud C, et al. Toward systems neuroscience of ADHD: a meta-analysis of 55 fMRI studies. *Am J Psychiatry.* 2012;169(10):1038-1055.
5. Skirrow C, Asherson P. Emotional lability, comorbidity and impairment in adults with attention-deficit hyperactivity disorder. *J Affect Disord.* 2013;147(1-3):80-86.
6. Graziano PA, Garcia A. Attention-deficit hyperactivity disorder and children's emotion dysregulation: A meta-analysis. *Clin Psychol Rev.* 2016;46:106-123.
7. Martel MM. Research review: a new perspective on attention-deficit/hyperactivity disorder: emotion dysregulation and trait models. *Journal of child psychology and psychiatry, and allied disciplines.* 2009;50(9):1042-1051.
8. Ramsay JR, Rostain AL. Adult ADHD research: current status and future directions. *J Atten Disord.* 2008;11(6):624-627.
9. Yoon SY, Jain U, Shapiro C. Sleep in attention-deficit/hyperactivity disorder in children and adults: past, present, and future. *Sleep medicine reviews.* 2012;16(4):371-388.
10. Sung V, Hiscock H, Sciberras E, Efron D. Sleep problems in children with attention-deficit/hyperactivity disorder: prevalence and the effect on the child and family. *Arch Pediatr Adolesc Med.* 2008;162(4):336-342.
11. Kirov R, Kinkelbur J, Banaschewski T, Rothenberger A. Sleep patterns in children with attention-deficit/hyperactivity disorder, tic disorder, and comorbidity. *Journal of child psychology and psychiatry, and allied disciplines.* 2007;48(6):561-570.
12. Kirov R, Brand S, Kolev V, Yordanova J. The sleeping brain and the neural basis of emotions. *Behav Brain Sci.* 2012;35(3):155-156.
13. Gruber R. Sleep characteristics of children and adolescents with attention deficit-hyperactivity disorder. *Child Adolesc Psychiatr Clin N Am.* 2009;18(4):863-876.
14. Gruber R, Wiebe S, Montecalvo L, Brunetti B, Amsel R, Carrier J. Impact of sleep restriction on neurobehavioral functioning of children with attention deficit hyperactivity disorder. *Sleep.* 2011;34(3):315-323.
15. Konofal E, Lecendreux M, Cortese S. Sleep and ADHD. *Sleep Med.* 2010;11(7):652-658.
16. Cortese S, Brown TE, Corkum P, et al. Assessment and management of sleep problems in youths with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2013;52(8):784-796.
17. Owens J, Gruber R, Brown T, et al. Future research directions in sleep and ADHD: report of a consensus working group. *J Atten Disord.* 2013;17(7):550-564.
18. Quach J, Hiscock H, Wake M. Sleep problems and mental health in primary school new entrants: cross-sectional community-based study. *J Paediatr Child Health.* 2012;48(12):1076-1081.
19. Becker SP, Lienesch JA. Nighttime media use in adolescents with ADHD: links to sleep problems and internalizing symptoms. *Sleep Med.* 2018;51:171-178.
20. Bourchtein E, Langberg JM, Cusick CN, Breaux RP, Smith ZR, Becker SP. Featured Article: Technology Use and Sleep in Adolescents With and Without Attention-Deficit/Hyperactivity Disorder. *Journal of pediatric psychology.* 2019;44(5):517-526.

21. Engelhardt CR, Mazurek MO, Sohl K. Media use and sleep among boys with autism spectrum disorder, ADHD, or typical development. *Pediatrics.* 2013;132(6):1081-1089.
22. Owens JA, Spirito A, McGuinn M, Nobile C. Sleep habits and sleep disturbance in elementary school-aged children. *J Dev Behav Pediatr.* 2000;21(1):27-36.
23. Ball JD, Tiernan M, Janusz J, Furr A. Sleep patterns among children with attention-deficit hyperactivity disorder: a reexamination of parent perceptions. *Journal of pediatric psychology.* 1997;22(3):389-398.
24. Golan N, Shahar E, Ravid S, Pillar G. Sleep disorders and daytime sleepiness in children with attention-deficit/hyperactive disorder. *Sleep.* 2004;27(2):261-266.
25. Gamble KL, May RS, Besing RC, Tankersly AP, Fargason RE. Delayed sleep timing and symptoms in adults with attention-deficit/hyperactivity disorder: a controlled actigraphy study. *Chronobiology international.* 2013;30(4):598-606.
26. O'Brien LM, Holbrook CR, Mervis CB, et al. Sleep and neurobehavioral characteristics of 5- to 7-year-old children with parentally reported symptoms of attention-deficit/hyperactivity disorder. *Pediatrics.* 2003;111(3):554-563.
27. Vélez-Galarraga R, Guillén-Grima F, Crespo-Eguílaz N, Sánchez-Carpintero R. Prevalence of sleep disorders and their relationship with core symptoms of inattention and hyperactivity in children with attention-deficit/hyperactivity disorder. *Eur J Paediatr Neurol.* 2016;20(6):925-937.
28. Moreau V, Rouleau N, Morin CM. Sleep of children with attention deficit hyperactivity disorder: actigraphic and parental reports. *Behav Sleep Med.* 2014;12(1):69-83.
29. Wynchank D, Ten Have M, Bijlenga D, et al. The Association Between Insomnia and Sleep Duration in Adults With Attention-Deficit Hyperactivity Disorder: Results From a General Population Study. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine.* 2018;14(3):349-357.
30. Rocca FL, Finotti E, Pizza F, et al. Psychosocial Profile and Quality of Life in Children With Type 1 Narcolepsy: A Case-Control Study. *Sleep.* 2016;39(7):1389-1398.
31. Rubia K. Cognitive Neuroscience of Attention Deficit Hyperactivity Disorder (ADHD) and Its Clinical Translation. *Front Hum Neurosci.* 2018;12:100.
32. Shao Y, Wang L, Ye E, et al. Decreased thalamocortical functional connectivity after 36 hours of total sleep deprivation: evidence from resting state FMRI. *PLoS One.* 2013;8(10):e78830.
33. Tomasi D, Wang RL, Telang F, et al. Impairment of attentional networks after 1 night of sleep deprivation. *Cereb Cortex.* 2009;19(1):233-240.
34. Chee MW, Chuah LY, Venkatraman V, Chan WY, Philip P, Dinges DF. Functional imaging of working memory following normal sleep and after 24 and 35 h of sleep deprivation: Correlations of fronto-parietal activation with performance. *Neuroimage.* 2006;31(1):419-428.
35. Chee MW, Chuah YM. Functional neuroimaging and behavioral correlates of capacity decline in visual short-term memory after sleep deprivation. *Proc Natl Acad Sci U S A.* 2007;104(22):9487-9492.
36. Turnbull K, Reid GJ, Morton JB. Behavioral Sleep Problems and their Potential Impact on Developing Executive Function in Children. *Sleep.* 2013;36(7):1077-1084.
37. Bernier A, Carlson SM, Bordeleau S, Carrier J. Relations between physiological and cognitive regulatory systems: infant sleep regulation and subsequent executive functioning. *Child Dev.* 2010;81(6):1739-1752.
38. Jan JE, Reiter RJ, Bax MC, Ribary U, Freeman RD, Wasdell MB. Long-term sleep disturbances in children: a cause of neuronal loss. *Eur J Paediatr Neurol.* 2010;14(5):380-390.
39. Shao Y, Lei Y, Wang L, et al. Altered resting-state amygdala functional connectivity after 36 hours of total sleep deprivation. *PLoS One.* 2014;9(11):e112222.

40. Yoo SS, Gujar N, Hu P, Jolesz FA, Walker MP. The human emotional brain without sleep--a prefrontal amygdala disconnect. *Curr Biol.* 2007;17(20):R877-878.
41. Sotres-Bayon F, Bush DE, LeDoux JE. Emotional perseveration: an update on prefrontal-amygdala interactions in fear extinction. *Learn Mem.* 2004;11(5):525-535.
42. Lawson RA, Papadakis AA, Higginson CI, et al. Everyday executive function impairments predict comorbid psychopathology in autism spectrum and attention deficit hyperactivity disorders. *Neuropsychology.* 2015;29(3):445-453.
43. Connor DF, Ford JD. Comorbid symptom severity in attention-deficit/hyperactivity disorder: a clinical study. *J Clin Psychiatry.* 2012;73(5):711-717.
44. Hansen BH, Skirbekk B, Oerbeck B, Wentzel-Larsen T, Kristensen H. Associations between sleep problems and attentional and behavioral functioning in children with anxiety disorders and ADHD. *Behav Sleep Med.* 2014;12(1):53-68.
45. Rubens SL, Evans SC, Becker SP, Fite PJ, Tountas AM. Self-Reported Time in Bed and Sleep Quality in Association with Internalizing and Externalizing Symptoms in School-Age Youth. *Child Psychiatry Hum Dev.* 2017;48(3):455-467.
46. Becker SP, Langberg JM, Evans SW. Sleep problems predict comorbid externalizing behaviors and depression in young adolescents with attention-deficit/hyperactivity disorder. *Eur Child Adolesc Psychiatry.* 2015;24(8):897-907.
47. Quach JL, Nguyen CD, Williams KE, Sciberras E. Bidirectional Associations Between Child Sleep Problems and Internalizing and Externalizing Difficulties From Preschool to Early Adolescence. *JAMA Pediatr.* 2018;172(2):e174363.
48. Kang NR, Kwack YS. Temperament and Character Profiles Associated with Internalizing and Externalizing Problems in Children with Attention Deficit Hyperactivity Disorder. *Psychiatry Investig.* 2019;16(3):206-212.
49. Jafari B, Mohsenin V. Polysomnography. *Clin Chest Med.* 2010;31(2):287-297.
50. Morgenthaler T, Alessi C, Friedman L, et al. Practice parameters for the use of actigraphy in the assessment of sleep and sleep disorders: an update for 2007. *Sleep.* 2007;30(4):519-529.
51. Marino M, Li Y, Rueschman MN, et al. Measuring sleep: accuracy, sensitivity, and specificity of wrist actigraphy compared to polysomnography. *Sleep.* 2013;36(11):1747-1755.
52. Sadeh A. The role and validity of actigraphy in sleep medicine: an update. *Sleep medicine reviews.* 2011;15(4):259-267.
53. Coto J, Garcia A, Hart KC, Graziano PA. Associations Between Disruptive Behavior Problems, Parenting Factors, and Sleep Problems Among Young Children. *J Dev Behav Pediatr.* 2018;39(8):610-620.
54. Virring A, Lambek R, Jennum PJ, Moller LR, Thomsen PH. Sleep Problems and Daily Functioning in Children With ADHD: An Investigation of the Role of Impairment, ADHD Presentations, and Psychiatric Comorbidity. *J Atten Disord.* 2017;21(9):731-740.
55. Waxmonsky JG, Mayes SD, Calhoun SL, et al. The association between Disruptive Mood Dysregulation Disorder symptoms and sleep problems in children with and without ADHD. *Sleep Med.* 2017;37:180-186.
56. Mulraney M, Giallo R, Lycett K, Mensah F, Sciberras E. The bidirectional relationship between sleep problems and internalizing and externalizing problems in children with ADHD: a prospective cohort study. *Sleep Med.* 2016;17:45-51.
57. Lycett K, Sciberras E, Hiscock H, Mensah FK. Sleep Problem Trajectories and Well-Being in Children with Attention-Deficit Hyperactivity Disorder: A Prospective Cohort Study. *J Dev Behav Pediatr.* 2016;37(5):405-414.
58. Becker SP, Epstein JN, Tamm L, et al. Shortened Sleep Duration Causes Sleepiness, Inattention, and Oppositionality in Adolescents With Attention-Deficit/Hyperactivity

Disorder: Findings From a Crossover Sleep Restriction/Extension Study. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2019;58(4):433-442.
59. Mulraney M, Zendarski N, Mensah F, Hiscock H, Sciberras E. Do early internalizing and externalizing problems predict later irritability in adolescents with attention-deficit/hyperactivity disorder? *Aust N Z J Psychiatry.* 2017;51(4):393-402.
60. Bar M, Efron M, Gothelf D, Kushnir J. The link between parent and child sleep disturbances in children with attention deficit/hyperactivity disorder. *Sleep Med.* 2016;21:160-164.
61. Becker SP, Pfiffner LJ, Stein MA, Burns GL, McBurnett K. Sleep habits in children with attention-deficit/hyperactivity disorder predominantly inattentive type and associations with comorbid psychopathology symptoms. *Sleep Med.* 2016;21:151-159.
62. Becker SP, Tamm L, Epstein JN, Beebe DW. Impact of sleep restriction on affective functioning in adolescents with attention-deficit/hyperactivity disorder. *Journal of child psychology and psychiatry, and allied disciplines.* 2020.
63. Balazs J, Kereszteny A. Attention-deficit/hyperactivity disorder and suicide: A systematic review. *World J Psychiatry.* 2017;7(1):44-59.
64. Daviss WB. A review of co-morbid depression in pediatric ADHD: etiology, phenomenology, and treatment. *J Child Adolesc Psychopharmacol.* 2008;18(6):565-571.
65. Ranum BM, Wichstrøm L, Pallesen S, Falch-Madsen J, Halse M, Steinsbekk S. Association Between Objectively Measured Sleep Duration and Symptoms of Psychiatric Disorders in Middle Childhood. *JAMA Netw Open.* 2019;2(12):e1918281.
66. Gruber R, Carrey N, Weiss SK, et al. Position statement on pediatric sleep for psychiatrists. *J Can Acad Child Adolesc Psychiatry.* 2014;23(3):174-195.
67. Hale L, Kirschen GW, LeBourgeois MK, et al. Youth Screen Media Habits and Sleep: Sleep-Friendly Screen Behavior Recommendations for Clinicians, Educators, and Parents. *Child Adolesc Psychiatr Clin N Am.* 2018;27(2):229-245.
68. Kjeldsen JS, Hjorth MF, Andersen R, et al. Short sleep duration and large variability in sleep duration are independently associated with dietary risk factors for obesity in Danish school children. *Int J Obesity.* 2014;38(1):32-39.
69. Marcus CL, Brooks LJ, Draper KA, et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics.* 2012;130(3):e714-755.
70. Kaditis AG, Alonso Alvarez ML, Boudewyns A, et al. Obstructive sleep disordered breathing in 2- to 18-year-old children: diagnosis and management. *Eur Respir J.* 2016;47(1):69-94.
71. Mohri I, Kato-Nishimura K, Kagitani-Shimono K, et al. Evaluation of oral iron treatment in pediatric restless legs syndrome (RLS). *Sleep Med.* 2012;13(4):429-432.
72. Garcia-Borreguero D, Larrosa O, de la Llave Y, Verger K, Masramon X, Hernandez G. Treatment of restless legs syndrome with gabapentin: a double-blind, cross-over study. *Neurology.* 2002;59(10):1573-1579.
73. Lack L, Wright H, Kemp K, Gibbon S. The treatment of early-morning awakening insomnia with 2 evenings of bright light. *Sleep.* 2005;28(5):616-623.
74. Weitzman ED, Czeisler CA, Coleman RM, et al. Delayed sleep phase syndrome. A chronobiological disorder with sleep-onset insomnia. *Arch Gen Psychiatry.* 1981;38(7):737-746.
75. Auger RR, Burgess HJ, Emens JS, Deriy LV, Thomas SM, Sharkey KM. Clinical Practice Guideline for the Treatment of Intrinsic Circadian Rhythm Sleep-Wake Disorders: Advanced Sleep-Wake Phase Disorder (ASWPD), Delayed Sleep-Wake Phase Disorder (DSWPD), Non-24-Hour Sleep-Wake Rhythm Disorder (N24SWD), and Irregular Sleep-Wake Rhythm Disorder (ISWRD). An Update for 2015: An American Academy of Sleep Medicine Clinical Practice Guideline. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine.* 2015;11(10):1199-1236.

76. Morgenthaler TI, Owens J, Alessi C, et al. Practice parameters for behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep.* 2006;29(10):1277-1281.
77. de Bruin EJ, Bögels SM, Oort FJ, Meijer AM. Improvements of adolescent psychopathology after insomnia treatment: results from a randomized controlled trial over 1 year. *Journal of child psychology and psychiatry, and allied disciplines.* 2018;59(5):509-522.
78. de Bruin EJ, Bögels SM, Oort FJ, Meijer AM. Efficacy of Cognitive Behavioral Therapy for Insomnia in Adolescents: A Randomized Controlled Trial with Internet Therapy, Group Therapy and A Waiting List Condition. *Sleep.* 2015;38(12):1913-1926.
79. Gradisar M, Dohnt H, Gardner G, et al. A randomized controlled trial of cognitive-behavior therapy plus bright light therapy for adolescent delayed sleep phase disorder. *Sleep.* 2011;34(12):1671-1680.
80. Wise MS, Arand DL, Auger RR, Brooks SN, Watson NF. Treatment of narcolepsy and other hypersomnias of central origin. *Sleep.* 2007;30(12):1712-1727.
81. van Stralen J. Emotional dysregulation in children with attention-deficit/hyperactivity disorder. *Atten Defic Hyperact Disord.* 2016;8(4):175-187.
82. Carpena MX, Hutz MH, Salatino-Oliveira A, et al. CLOCK Polymorphisms in Attention-Deficit/Hyperactivity Disorder (ADHD): Further Evidence Linking Sleep and Circadian Disturbances and ADHD. *Genes (Basel).* 2019;10(2).
83. Li SX, Chan NY, Man Yu MW, et al. Eveningness chronotype, insomnia symptoms, and emotional and behavioural problems in adolescents. *Sleep Med.* 2018;47:93-99.
84. Curtis J, Burkley E, Burkley M. The Rhythm Is Gonna Get You: The Influence of Circadian Rhythm Synchrony on Self-Control Outcomes. *Social and Personality Psychology Compass.* 2014;8(11):609-625.
85. Rucklidge JJ. Gender differences in ADHD: implications for psychosocial treatments. *Expert Rev Neurother.* 2008;8(4):643-655.
86. El-Sheikh M, Kelly RJ, Bagley EJ, Wetter EK. Parental depressive symptoms and children's sleep: the role of family conflict. *Journal of child psychology and psychiatry, and allied disciplines.* 2012;53(7):806-814.
87. Johnson DA, Billings ME, Hale L. Environmental Determinants of Insufficient Sleep and Sleep Disorders: Implications for Population Health. *Curr Epidemiol Rep.* 2018;5(2):61-69.
88. School start times for adolescents. *Pediatrics.* 2014;134(3):642-649.
89. Owens J, Troxel W, Wahlstrom K. Commentary on Healthy School Start Times. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine.* 2017;13(5):761.